3

91605

916050

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Biology, 2017

91605 Demonstrate understanding of evolutionary processes leading to speciation

9.30 a.m. Thursday 16 November 2017
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of evolutionary processes leading to speciation.	Demonstrate in-depth understanding of evolutionary processes leading to speciation.	Demonstrate comprehensive understanding of evolutionary processes leading to speciation.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

ASSESSOR'S USE ONLY

QUESTION ONE

Distribution, dimensions, habitat preference, and bill morphology of moa

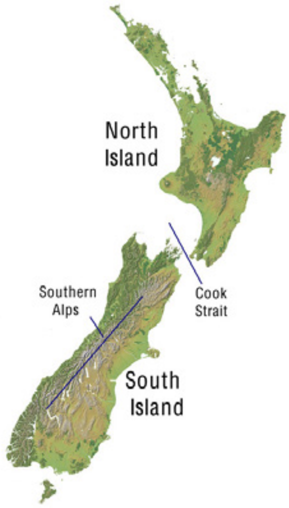
Dinornis

Family: Dinornithidae

Species: South Island giant moa (blue), North Island giant moa (red)

Dimensions: 56–249 kg and 90 to 200 cm in height – significant sexual dimorphism with females up to three times the mass of males.

Habitat: Browsing generalist – has been found in upland, lowland and open forest habitats.



P

Family: Emeidae

Species: Crested moa (green), Heavy-footed moa (blue), Mantell's moa (red)

Dimensions: 17–163 kg and 54 to 121 cm.

Habitat: Crested moa occupied subalpine grassland, Heavy-footed moa and Mantell's moa preferred lowland forest edges and wetland vegetation.

Anomalopteryx:

Family: Emeidae

Species: Little bush moa

Dimensions: 26–64 kg and 50 to 90 cm.

Habitat: Non-coastal lowland forests with a continuous canopy.

Euryapteryx:

Family: Emeidae

Species: Coastal moa

Dimensions: 12–109 kg and 51 to 103 cm.

Habitat: Drier climates – typically lowland open forest and coastal sites.

Megalapteryx:

Family: Megalapterygidae

Species: Upland moa

Dimensions: 28–80 kg and 65 to 95 cm.

Habitat: Subalpine scrub, grassland and high country forests (usually >900 m).

Adapted from: Bunce M, et al. 2009. 'The evolutionary history of the extinct ratite moa and New Zealand Neogene paleogeography'. *Proc. Natl. Acad Sci. USA*. 106: 20646–20651; and Attard M, et al. 2016. 'Moa diet fits the bill: virtual reconstruction incorporating mummified remains and prediction of biomechanical performance in avian giants'. *Proc. R. Soc*. 283: 2015–2043

Moa were the dominant group of herbivores in ecosystems in New Zealand/Aotearoa until their extinction about 550 years ago. Moa species had a wide diversity of sizes and significant differences in the structure, strength, shape, and biomechanical performance of the skull and bill. Evidence suggests a single lineage of moa existed 25 million years ago (mya) in the South Island. Recent genetic analysis indicates new species started emerging about 5.8 mya, and by 1.4 mya, all nine known species existed. Fossil evidence indicates many of these species overlapped in geographical range.

Analyse the events that may have led to evolution of the moa.

In your answer you should:

- describe the terms allopatric speciation and sympatric speciation
- describe the pattern of evolution shown by moa, AND explain how this type of pattern can arise
- discuss the evolutionary significance of the diversity in moa bill shape
- analyse the evolutionary processes that contributed to moa speciation.

There is more space for your answer to this question on the following page.

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

QUESTION TWO

https://vtnews.vt.edu/articles/2016/06/fralin-garter.html

The rough-skinned newt (*Taricha granulosa*) is distributed throughout North America. Many populations contain the poison tetrodotoxin (TTX) in the skin, which acts as a defence against predation. Despite TTX being one of the most powerful neurotoxins known, the garter snake (*Thamnophis sirtalis*) is able to prey on the rough-skinned newt. The levels of toxicity of newts and the resistance of the garter snakes vary geographically.

TTX Resistance vs Speed at which the garter snake can move

TTX resistance	Number of amino acid mutations	Speed at which the snake can move
Least resistant	1	fast
Intermediate resistant	2	intermediate
Most resistant	3	slow

Analyse the evolutionary relationship between the rough-skinned newt and the garter snake.

In your answer you should:

- describe the **pattern of evolution** shown by the relationship
- explain how this kind of relationship develops
- discuss the role of **natural selection and mutation** in the evolution of the features shown
- analyse the selection pressures that work both for AND against the relationship.

There is more space for your answer to this question on the following pages.

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

QUESTION THREE

Shireplitis is a newly discovered genus of wasp endemic to New Zealand / Aotearoa. These species are mostly found in moss, litter, or tussock grasslands, at moderate altitude on mountain ranges.

Paroplitis is an unrelated genus of wasp, mostly distributed in Europe and North America, with some species living at moderate altitudes.

Shireplitis and *Paroplitis* look similar, with shared features being their relatively small size with a body length of about 2 mm, short and smooth abdomen, dark colour, short and robust legs, and short antenna. *Shireplitis* and *Paroplitis* both parasitise caterpillars. Host caterpillars are only known for the European species *Paroplitis wesmaeli*. One of these host species feeds on moss while another feeds on moss and grasses. Biologists hypothesise that *Shireplitis* may parasitise caterpillars that feed on moss, leaf-litter, dead wood, or fungi.

The six species of *Shireplitis*.

http://microgastrinae.myspecies.info/microgastrinae/shireplitis

Paroplitis wesmaeli

http://microgastrinae.myspecies.info/gallery?f[0]=im_field_taxonomic_name%3A28649&f[1]=im_field_taxonomic_name%3A28644

Discuss the evolutionary pattern AND selection pressures that have contributed to this pattern for *Shireplitis* and *Paroplitis*.

In your answer:

- describe selection pressure AND the pattern of evolution shown by *Shireplitis* and *Paroplitis*
- describe homologous structures and analogous structures
- using the information above, explain how analogous structures are related to the pattern of evolution shown by *Shireplitis* and *Paroplitis*
- discuss, using the evidence from the resource material, how this evolutionary pattern could arise.

ASSESSOR'S USE ONLY

There is more space for your answer to this question on the following page.

ASSESSOR'S USE ONLY

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

91605